Renewables: The True Costs

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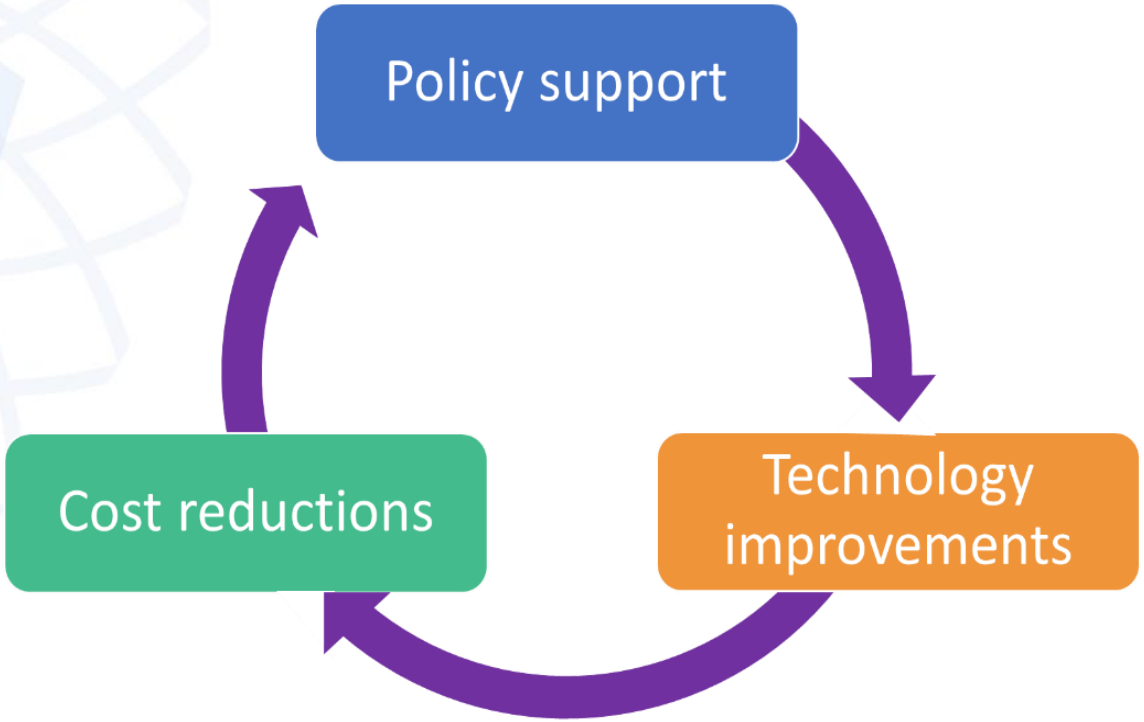
The Energy Sector is Being Transformed



A ***virtuous cycle*** is unlocking the ***economic***, ***social*** and ***environmental*** benefits of renewables

BUT

THE ABSENCE OF UP-TO-DATE COST DATA IS A BARRIER

IRENA IS RAMPING UP ITS WORK

THE IRENA RENEWABLE COST DATABASE

IRENA's database: Scope and coverage

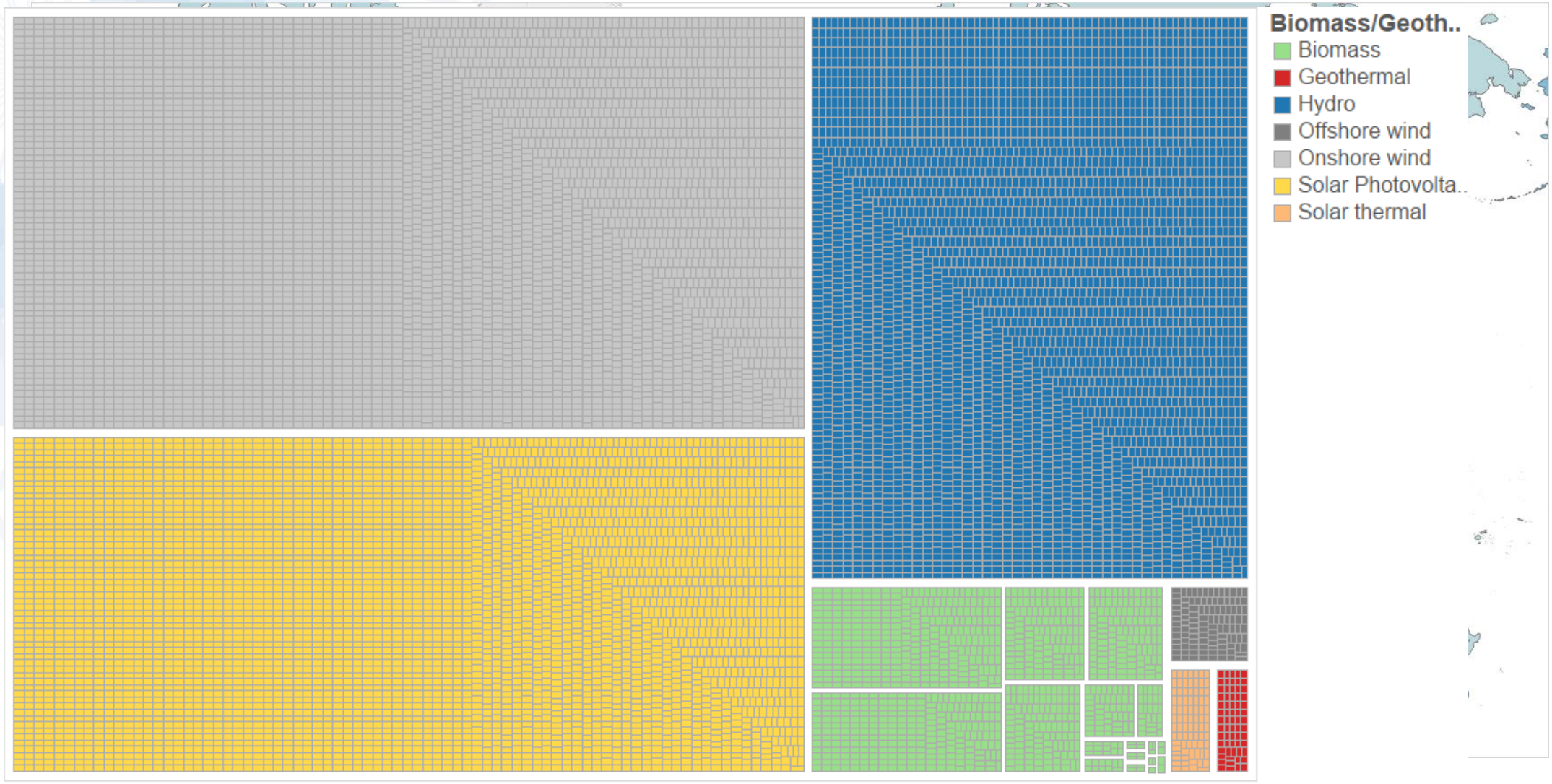
Power: 15000 utility-scale projects for LCOE,
¾ million small-scale solar PV

Smaller dataset on biofuels/EVs

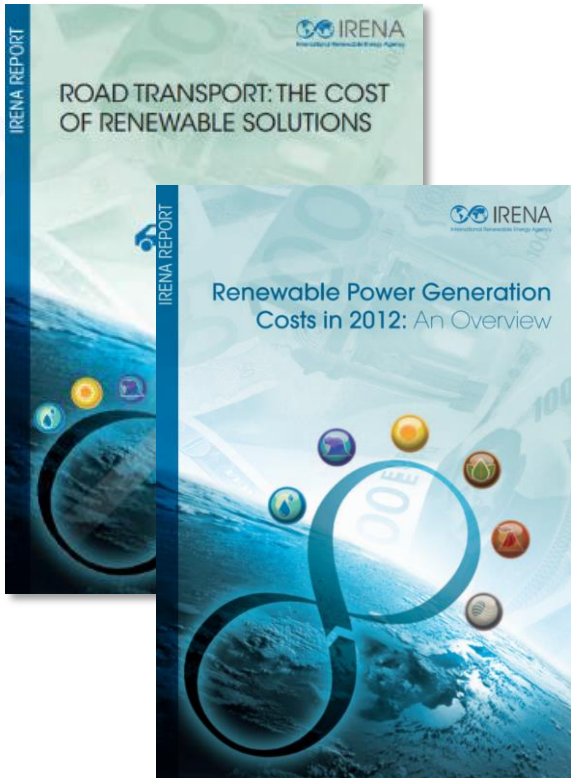
Stationary applications to be added in 2016/2017

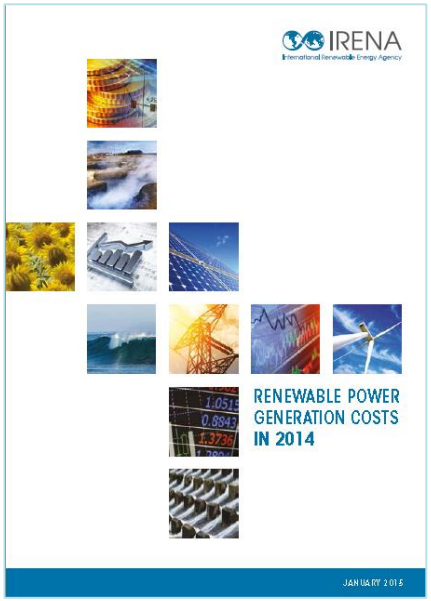
Power: database concentrated in non-OECD
as more publicly available information
(e.g. multi-lateral financing, delveopment projects, etc)

Power generation database



IRENA Costing Analysis Products





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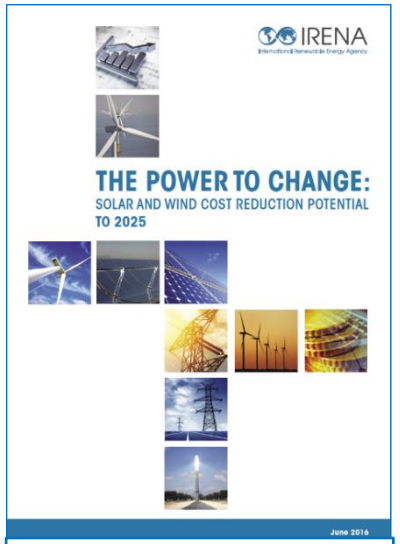

2012 **2013** **2015** **2016**

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Renewable Power Generation Costs in 2016

Highlights

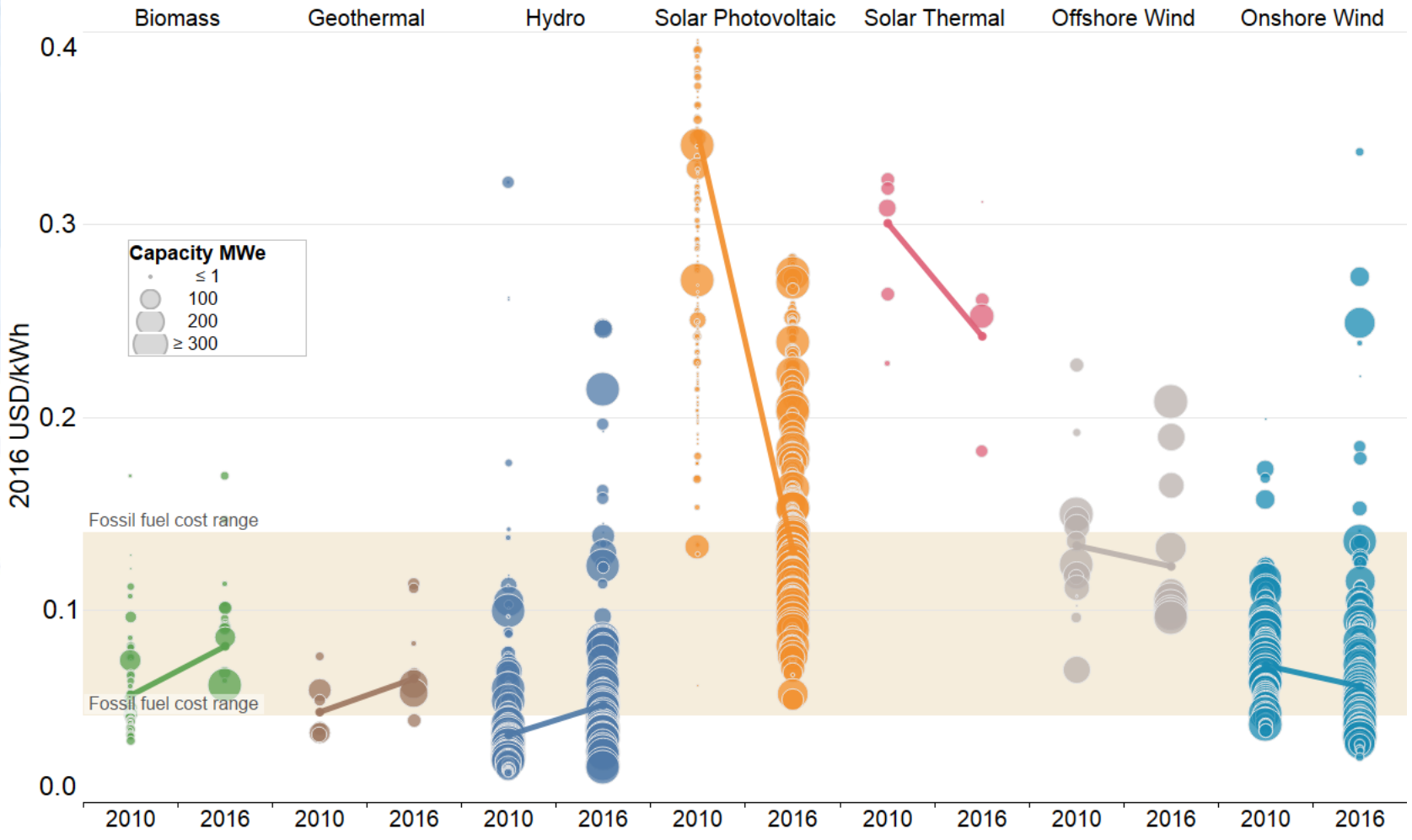
The relentless improvement in competiveness continues

Renewables competing head-to-head with fossil fuels

Integrating variable renewables doesn't change the conclusions

Future cost reductions will be more challenging, policy driven

Renewables: Highly competitive for new capacity



Traditional renewables highly competitive

Cost reductions for wind and solar, make them increasingly competitive

Cost rise for average hydro projects, geo & biomass data needs more work

Each circle represents one project, centre of circle is LCOE value on Y axis, diameter is size of project. Year is year commissioned.

Wind power costs are falling….

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Higher capacity factors from improved technology

+

Wind turbine cost reductions

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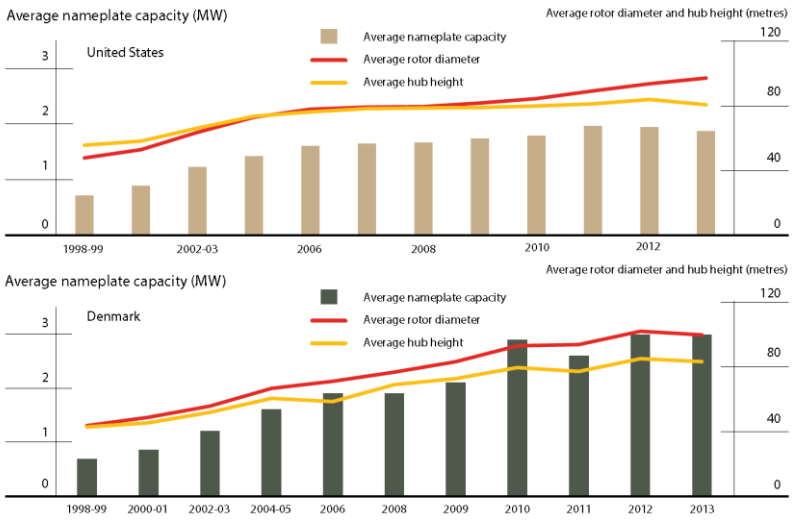
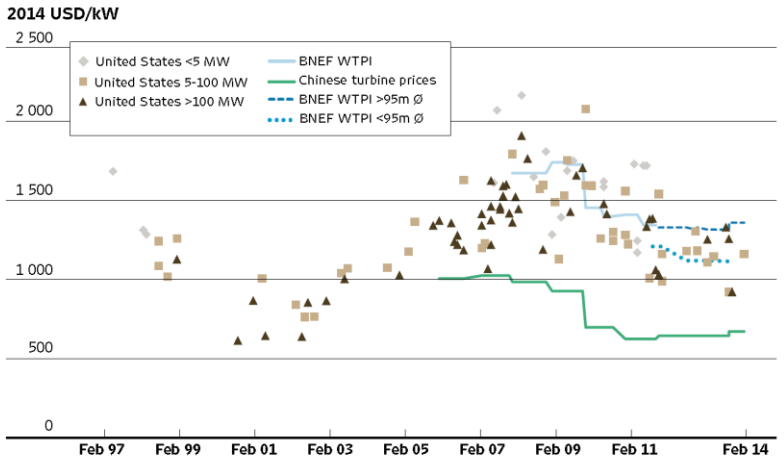
LCOEs are falling



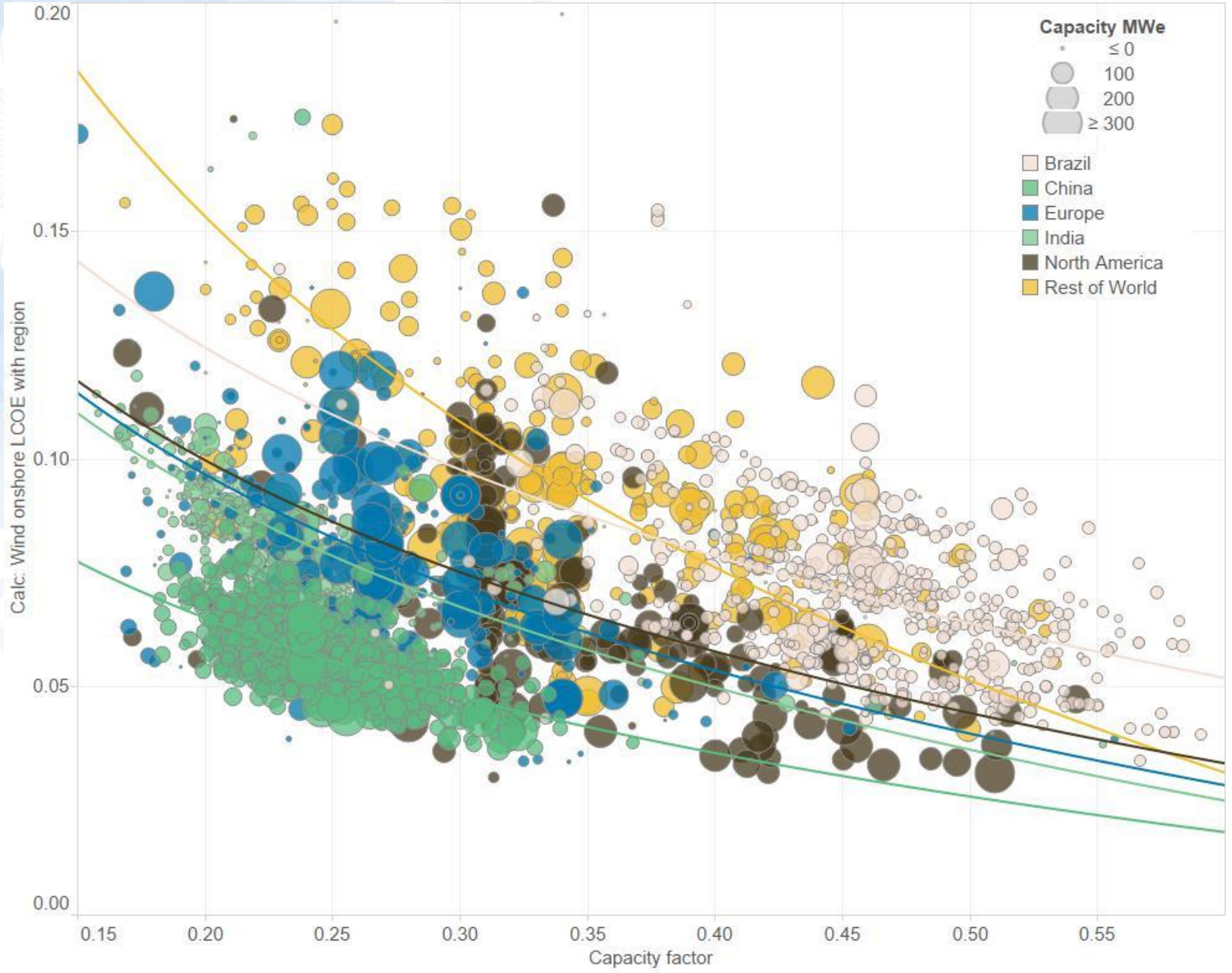
Sources: Wiser and Bollinger, 2014; Danish Energy Agency, 2014; and GlobalData, 2014



Sources: Wiser and Bollinger, 2014; CWEA, 2013; BNEF, 2014c; and Global Data, 2014.

Note: BNEF WTPI represents the half-year average for non-Asian markets, while the United States data are for the specific month of a particular turbine contract and the Chinese data are annual averages.

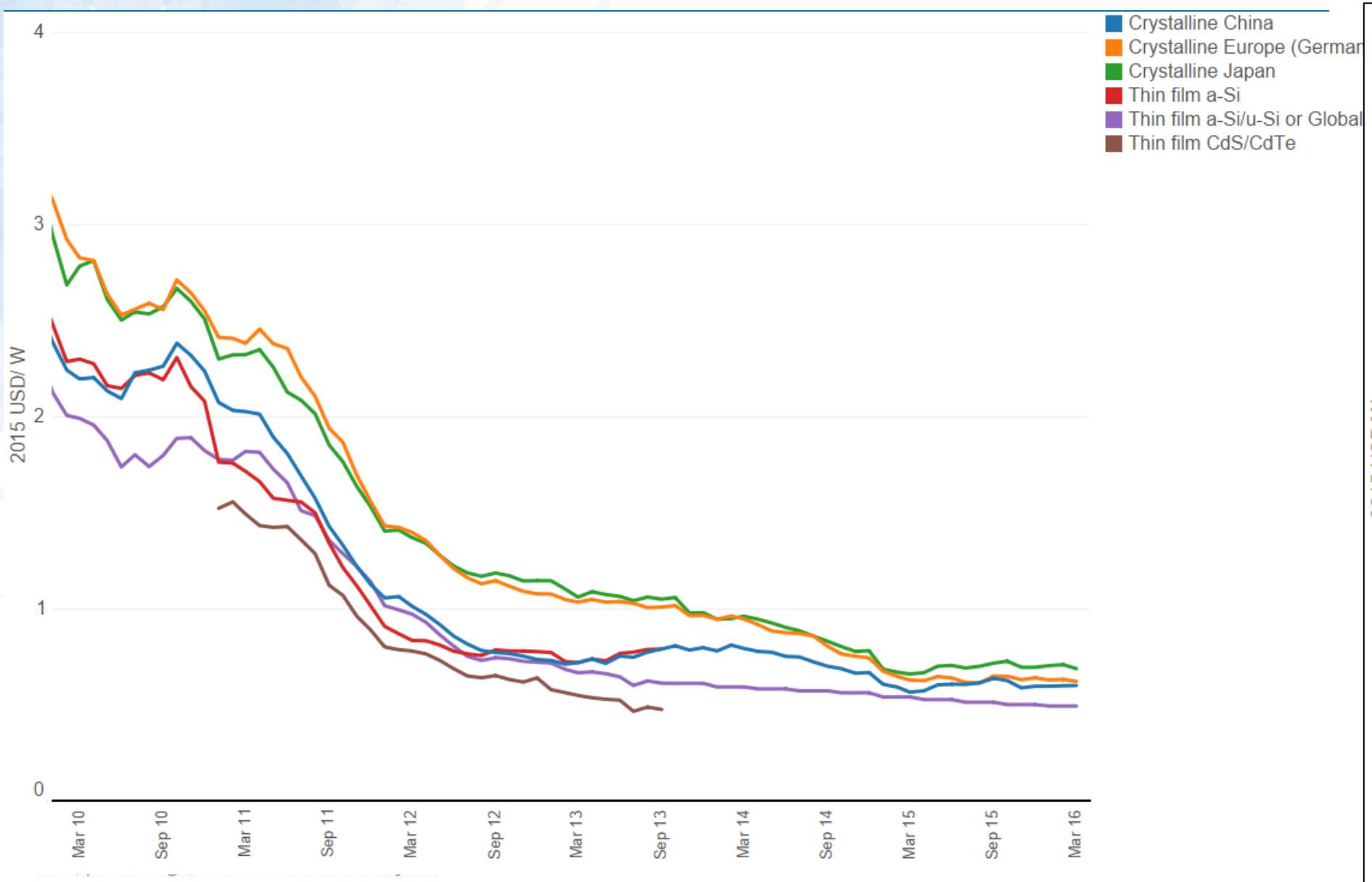
Onshore wind LCOE

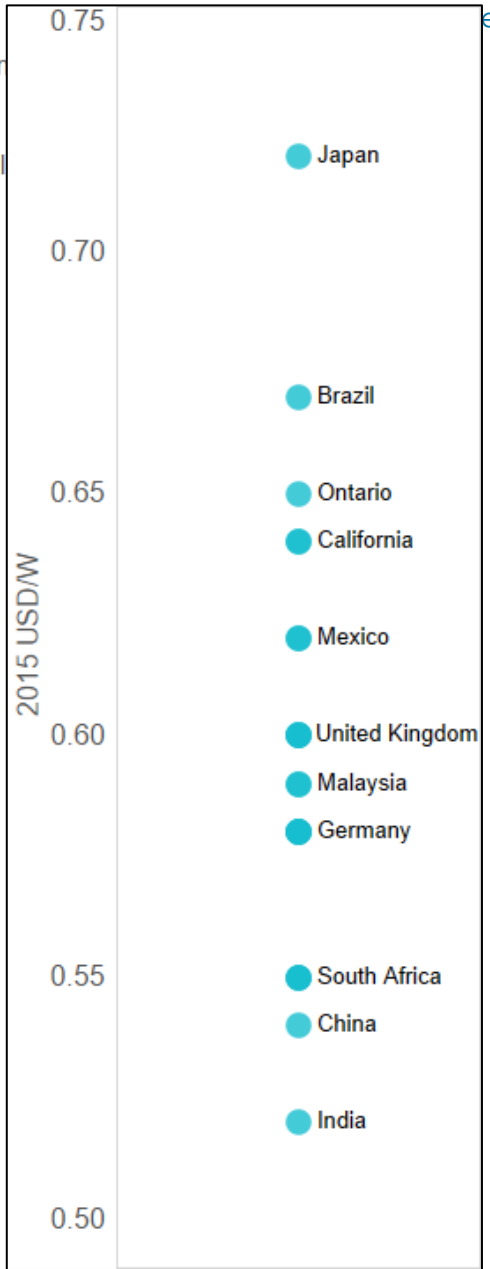


Competitive cost structures yield low LCOE's across a range of resource quality

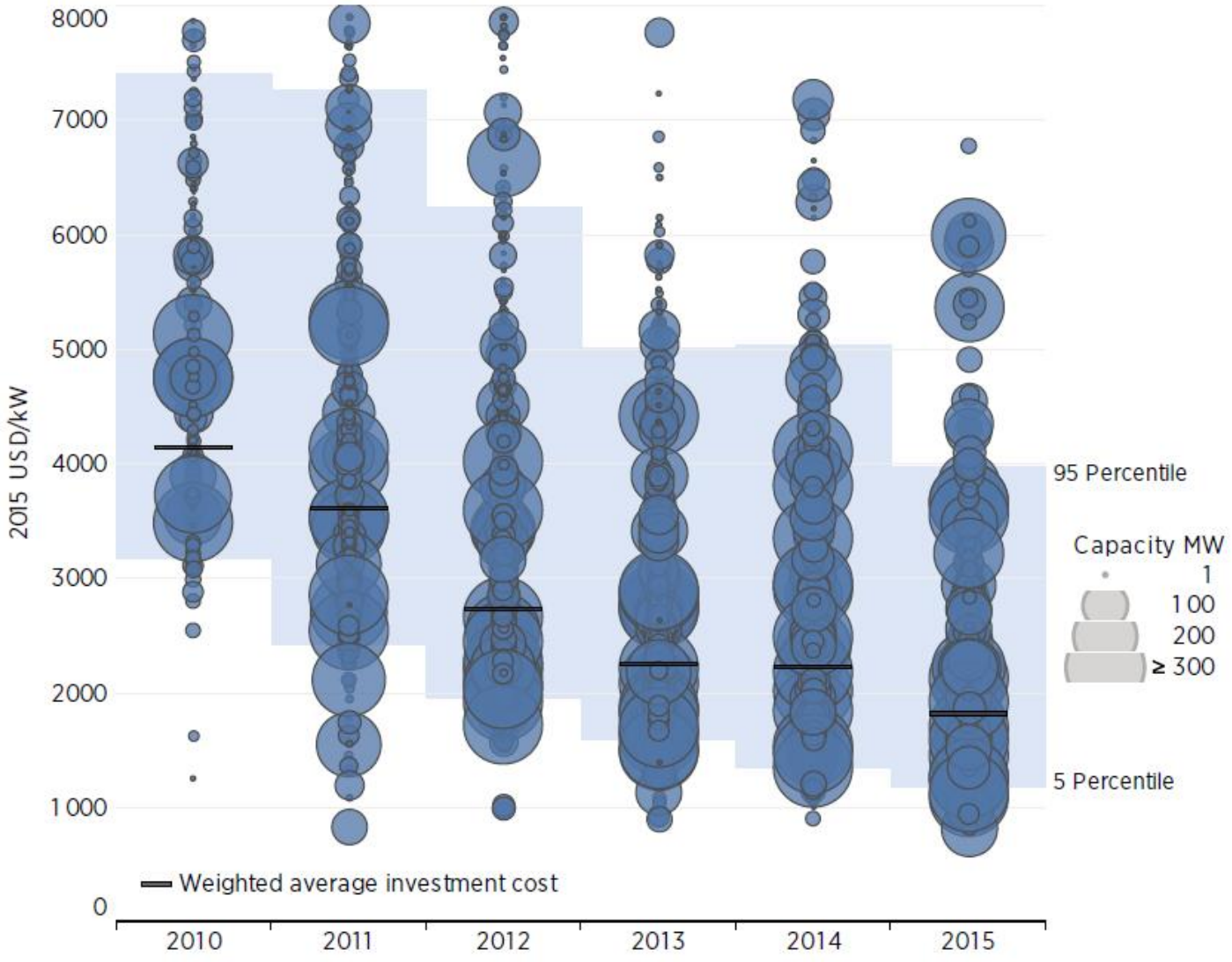
No clear trend by year of project installation for data available, better data required

Solar PV module prices in 2015/16





Solar PV utility-scale projects



Source: IRENA Renewable Cost Database.

Technology improvements
and
cost reductions

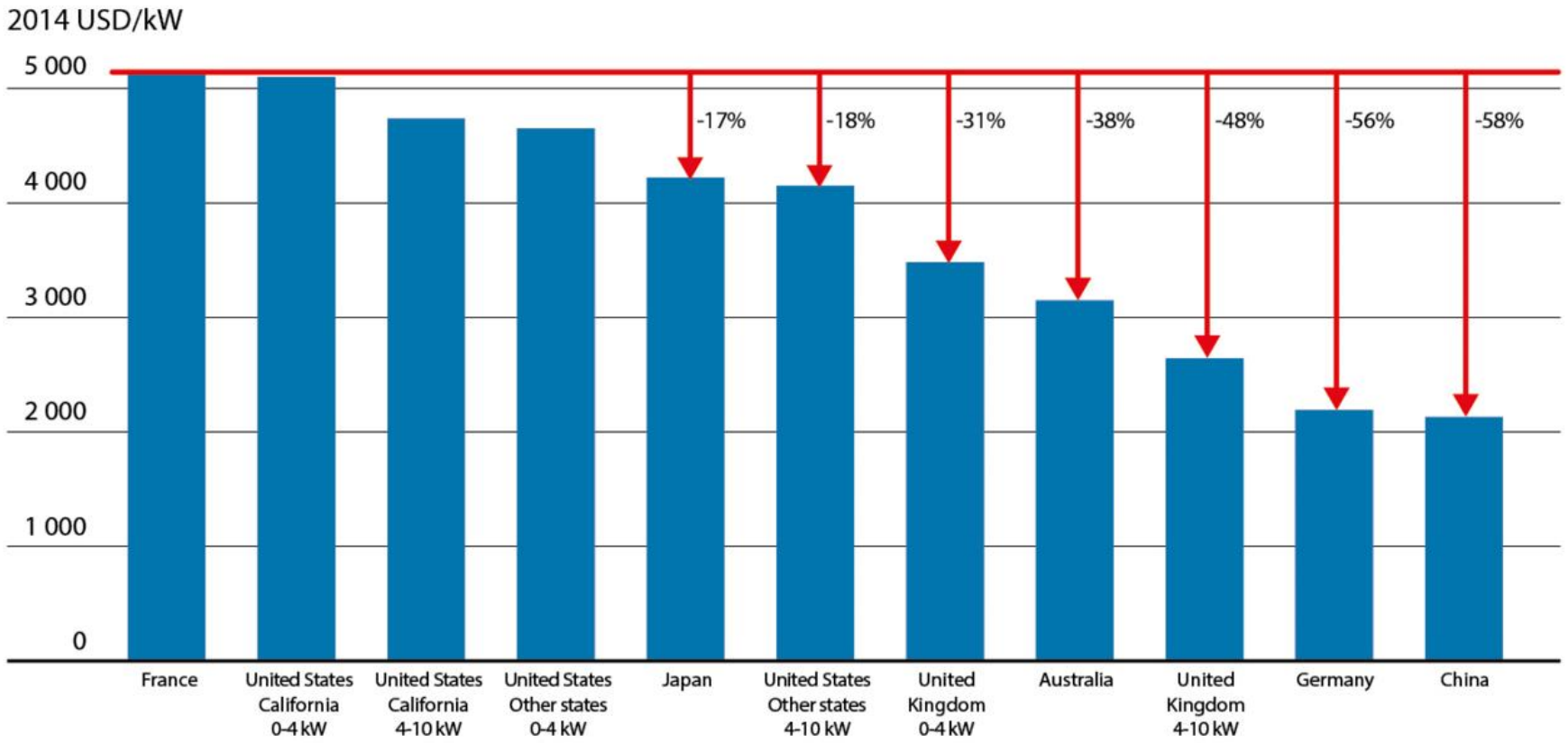
=

Falling LCOEs

Residential solar PV: Average cost differentials

RENEWABLE POWER GENERATION COSTS IN 2014

FIGURE 5.11: ESTIMATED AVERAGE TOTAL INSTALLED PV SYSTEM COSTS IN THE RESIDENTIAL SECTOR BY COUNTRY, 2014

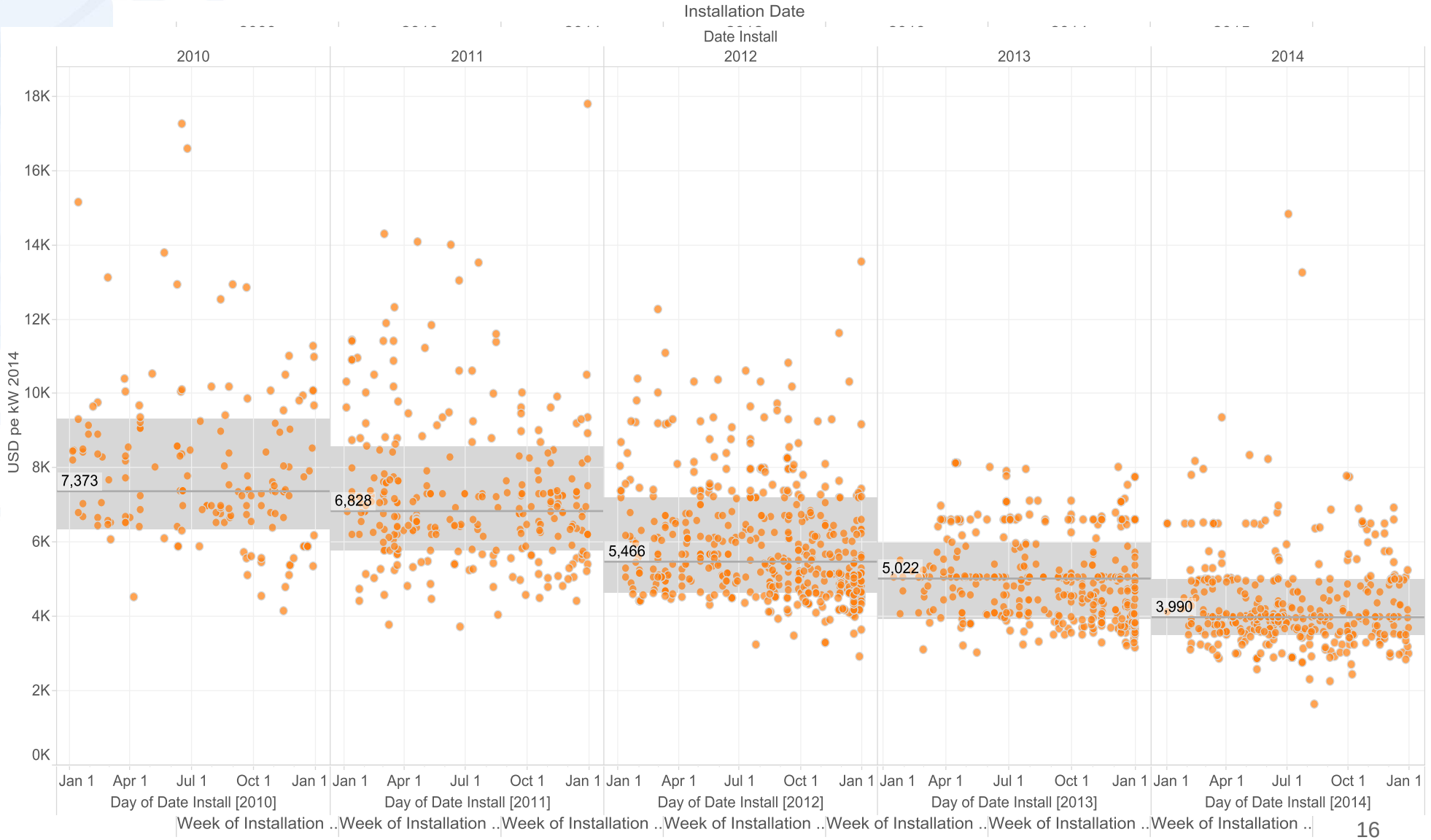


Source: IRENA Renewable Cost Database; DECC, 2014; GSE, 2014; IEA PVPS, 2014; and Photon Consulting, 2014.

COMMERCIAL SOLAR PV COSTS

Arizona

New York State



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SOLAR PV IN AFRICA: COSTS AND MARKETS

NEW OPPORTUNITIES UNLOCKED

Solar PV Costs in Africa

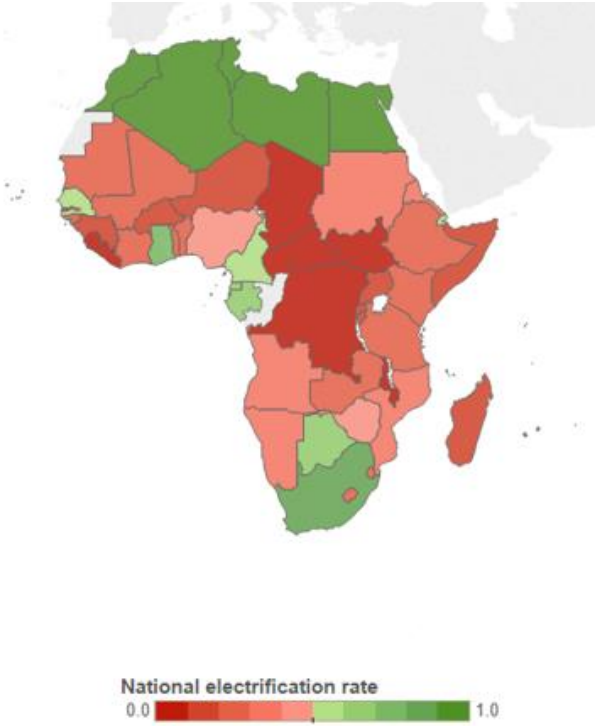
Africa has a need for power:
Solar resources make PV an excellent fit

But poor understanding of costs today

Data collection challenging, but encouraging results

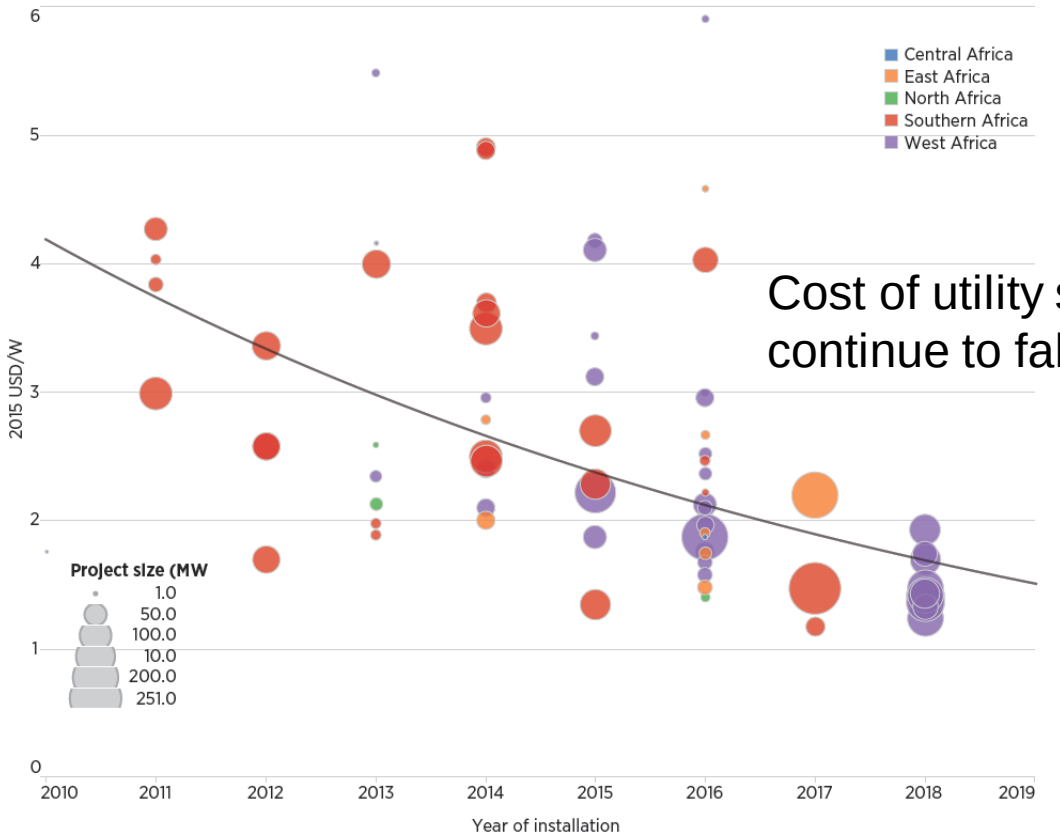
- Some markets relatively competitive
- Very small SHS cost structures are challenging
- Regional deep-dives necessary for greater clarity

~600 million lack access



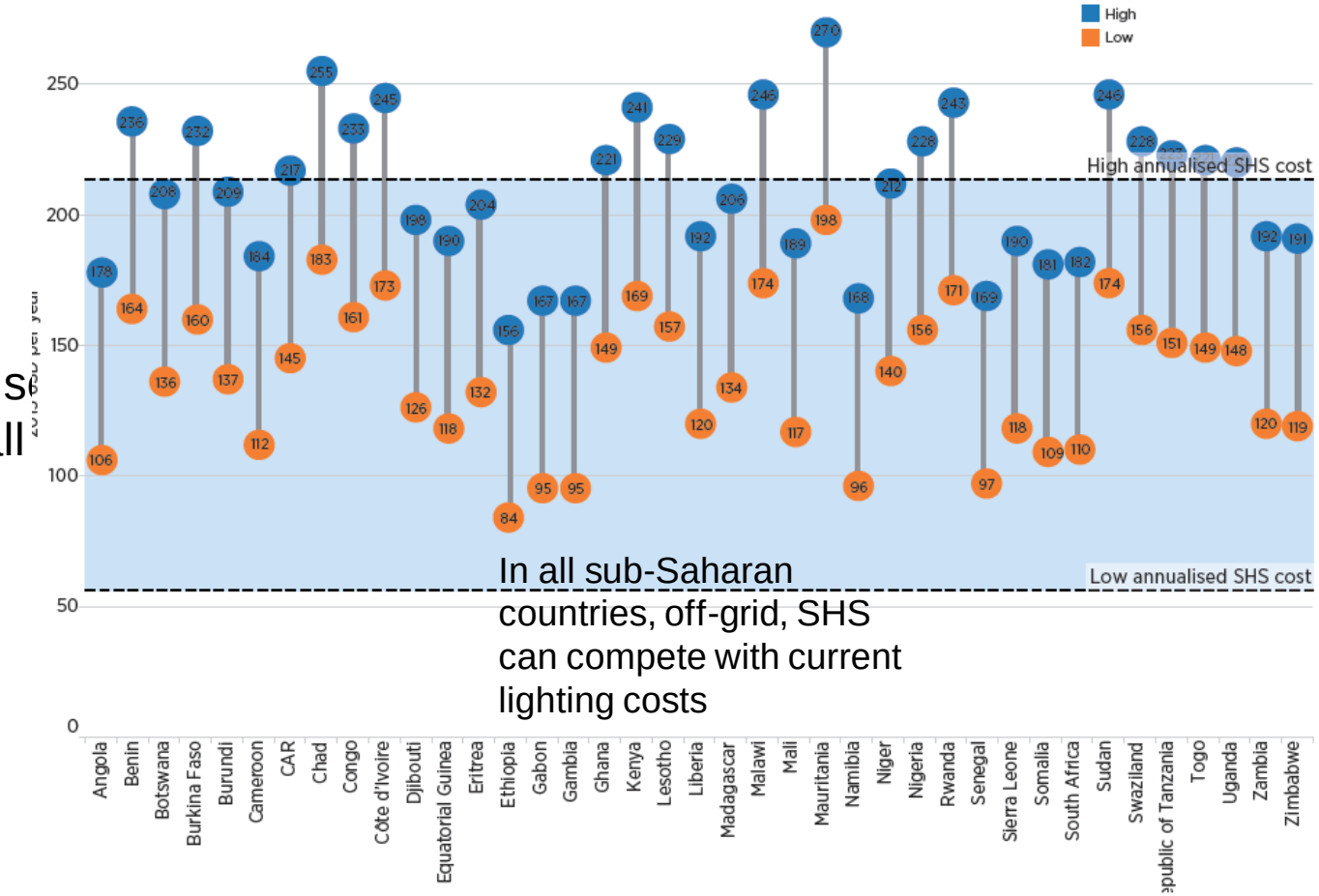
Solar PV costs in Africa: Utility-scale and SHS

Operating and proposed utility scale solar PV project installed costs in Africa, 2010-2018 (IRENA)



Source: IRENA Renewable Cost Database, 2016

Annual off-grid household expenditure on lighting and mobile phone charging compared to SHS (<1kW) annualized costs, by country (IRENA)



The Power to Change

Cost Reduction Potentials for Solar and Wind

Costs will continue to fall for solar and wind power technologies to 2025

Large cost differentials

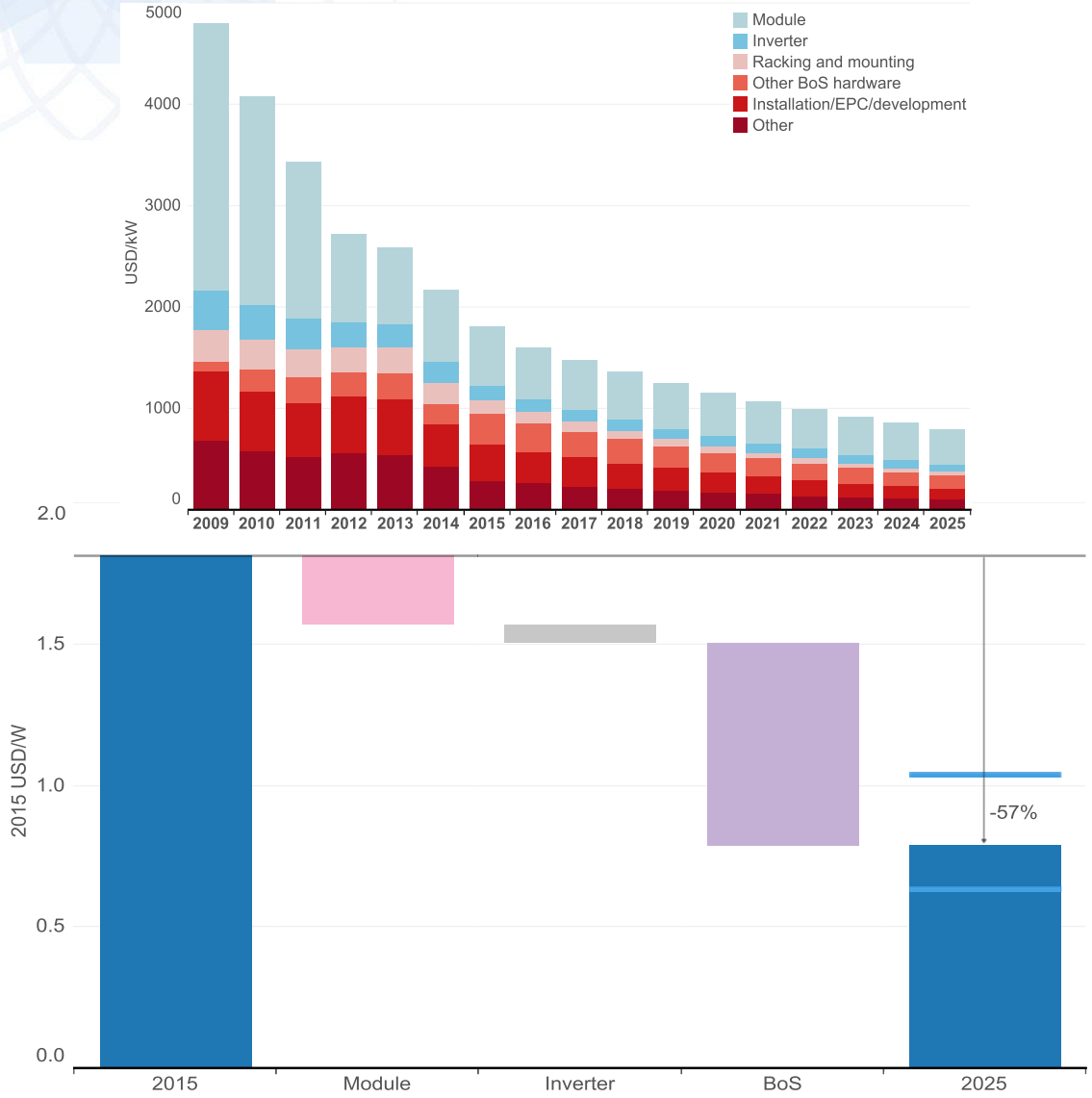
Continued technology innovation

Growing scale of markets

Policy framework critical to unlocking largest savings

Cost reduction drivers are changing

Solar PV:
Installed system costs to 2025



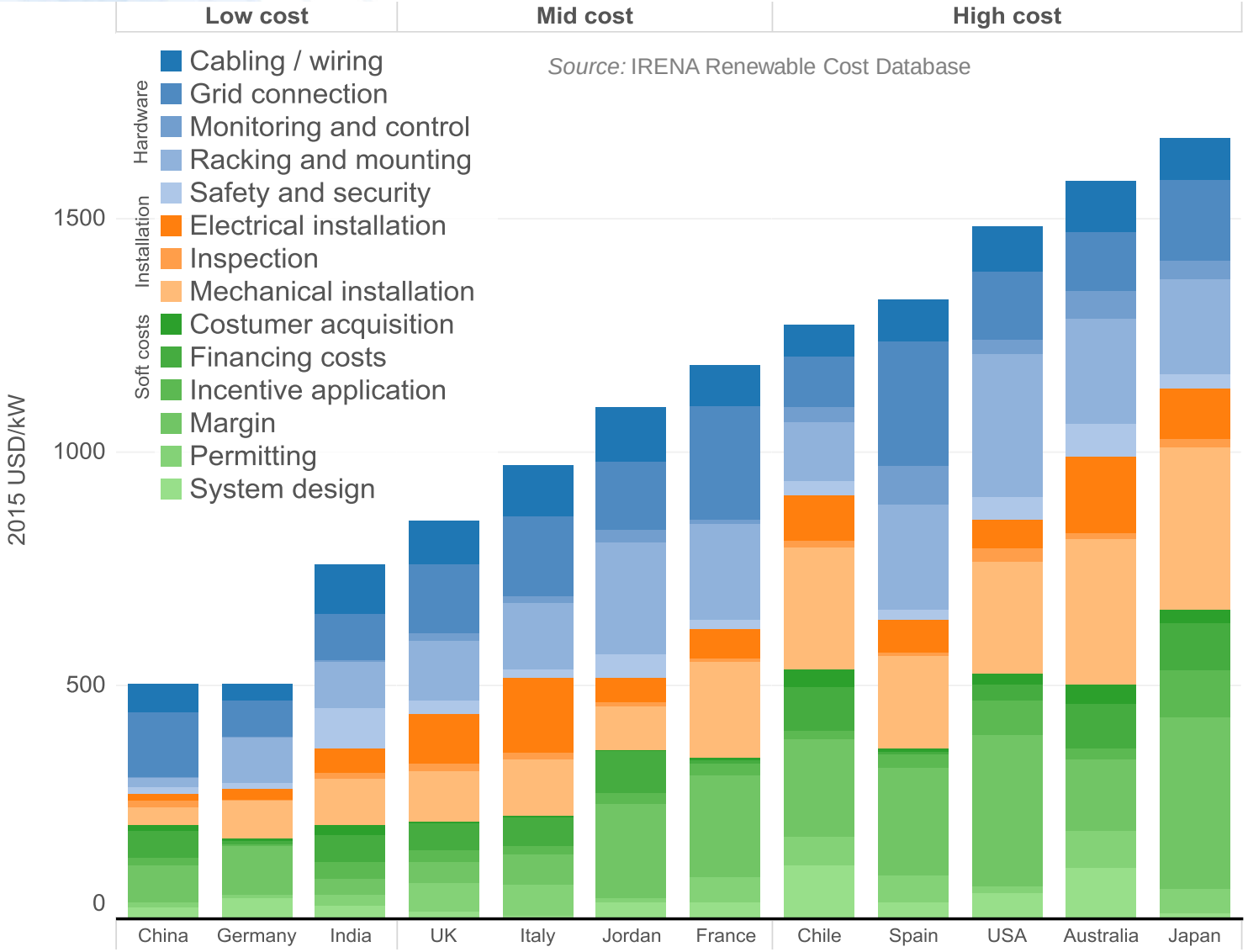
Large average cost reduction potential

BoS dominates potential

Will require action by policy makers

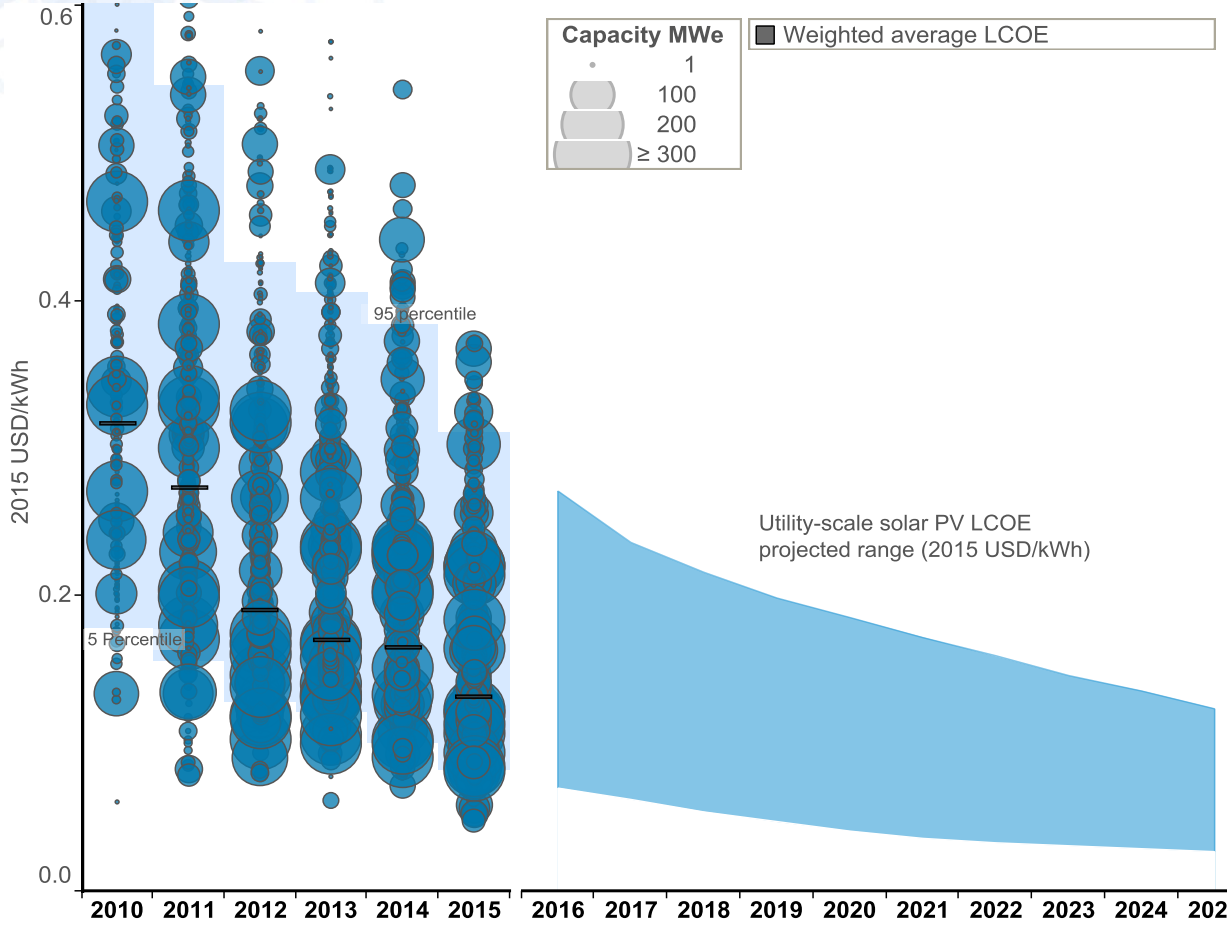
Solar PV: BoS costs

Detailed breakdown of solar PV BoS costs by country, 2015



The range of BoS costs between costs groups is very large, but BoS costs also present the greatest opportunities for reduction potential

Solar PV LCOE to 2025



Highly dependent on BoS convergence scenario

Upcoming cost analysis: Firm

PV parity indicators

Global wind learning curve

Stationary applications

Energy security

Battery markets & costs to 2025

RE financing costs

Renewables are increasingly competitive

The winners are customers, the environment and our future

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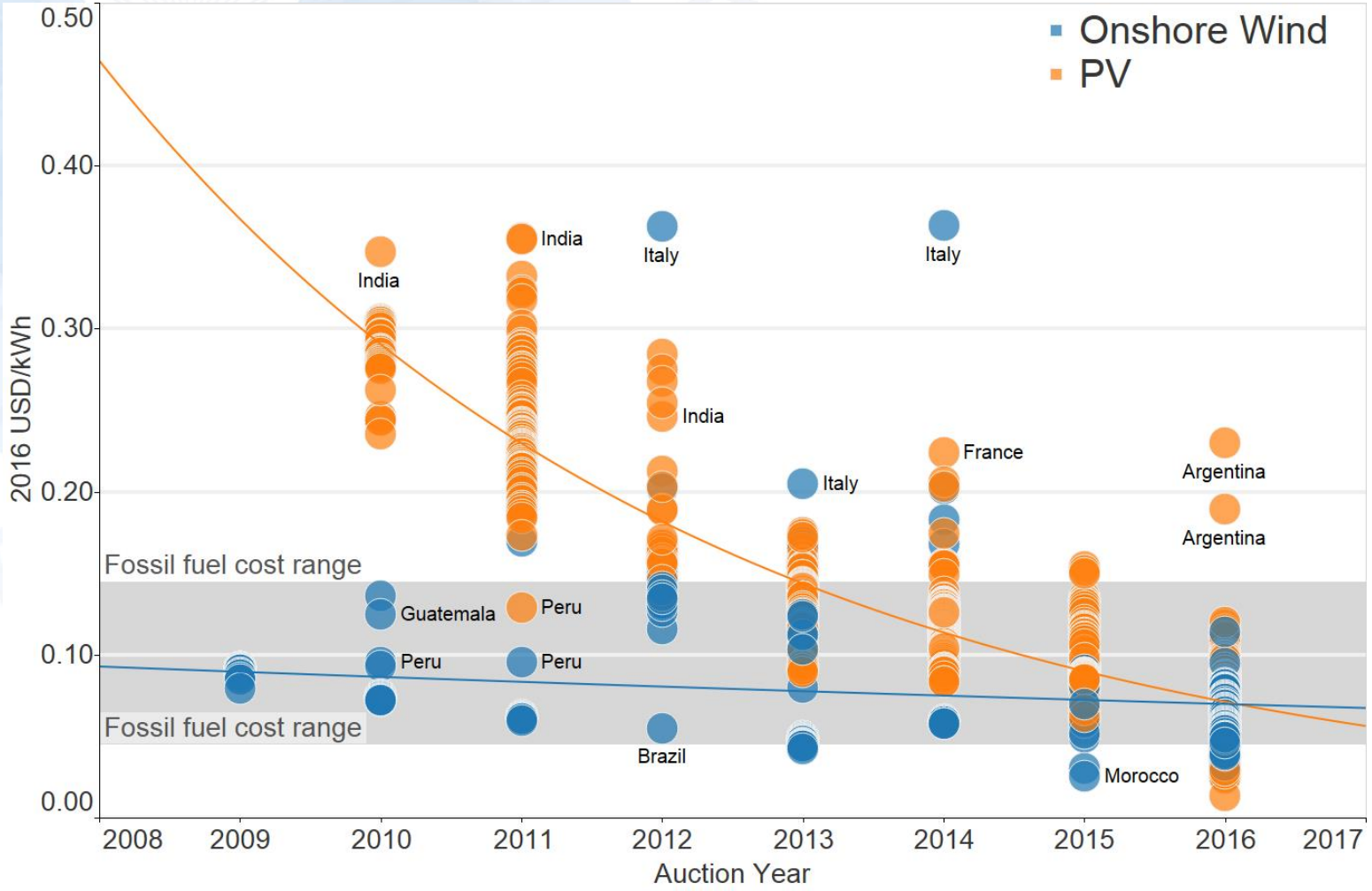
Tender and PPA results



Dramatic convergence of solar PV and onshore wind to same LCOE range

But some of these projects are "boundary" projects, difficult to replicate for solar PV